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(71) Applicants:
- T&N TECHNOLOGY LIMITED
Rugby Warwickshire, CV22 7SB (GB)
Designated Contracting States:
DE GB
- GLACIER GMBH - DEVA WERKE
35260 Stadtallendorf (DE)
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(72) Inventors:
- Fox, Katharine Margaret
Bilton, Rugby, Warwickshire CV22 7EW (GB)
- Roos, Udo
35315 Homberg / Orm (DE)
- Schwarze, Hubert
35037 Marburg (DE)

(74) Representative:
Moffat, John Andrew et al
T&N Limited Patent and Trade Mark Department,
Manchester International Office Centre,
Styal Road
Manchester M22 5TN (GB)

(54) Sintered stainless steel and manganese sulphide material for high temperature bearings

(57) A sintered material based upon stainless steel and manganese sulphide powders is described together with its method of manufacture. The material has good high temperature bearing characteristics.

EP 0 900 856 A1

Description

[0001] The present invention relates to sintered stainless steel materials, products made therefrom and to a method for their manufacture.

[0002] Known powder metal parts produced by conventional pressing and sintering processes are not well adapted for use in high temperature applications.

[0003] An example of such an application is as a bearing surface along which an ingot transporter would be conveyed through an annealing furnace. The bearing surface must support the load of the conveyor at high temperature, for example at 650°C when annealing aluminium alloy ingots.

[0004] The present invention has as an advantage the provision of load bearing sintered stainless steel based materials with improved high temperature wear characteristics.

[0005] According to a first aspect of the present invention a sintered stainless steel material is characterised in that it comprises from 2.5 to 30 wt% manganese sulphide.

[0006] Preferably the material also comprises 1 to 7 wt% titanium carbide

[0007] According to a second aspect of the invention a method of manufacturing a sintered product comprises the steps of

making a mixture of a stainless steel powder and manganese sulphide powder, the manganese sulphide comprising from 2.5 to 30 wt% of the mixture,
pressing the mixture and
sintering the mixture.

[0008] Preferably the stainless steel is 316L having the following composition: 0.03% C, 2% Mn, 1% Si, 16-18% Cr, 10-14% Ni, 0.045% P, 0.03% S, balance Fe.

[0009] Preferably the stainless steel powder is of particle size less than 150 μm.

[0010] Preferably the manganese sulphide powder is of particle size less than 50 μm.

[0011] Preferably the mixture is sintered at 1150°C for 1 hour, preferably in a cracked ammonia atmosphere. Alternatively, the mixture may be sintered for up to 2 hours in a vacuum atmosphere. In a further alternative, the mixture may be sintered in a hydrogen/nitrogen (H_2/N_2) atmosphere.

[0012] Preferably the mixture also comprises 1 to 7 wt% titanium carbide.

[0013] The present invention will now be described, by way of example only, with reference to the following Illustrative Example.

[0014] A stainless steel based powder mixture was prepared by mixing 80 wt% of 316L stainless steel powder with 20 wt% of manganese sulphide powder. The stainless steel powder was of particle size less than 150 μm. The manganese sulphide powder was of particle size less than 20 μm. The powders were thoroughly mixed using a rotating mixer. The powder mixture was then cold pressed into compacts. The compacts were then sintered at 1150°C for 1 hour in a vacuum.

[0015] The resulting sintered articles were examined to determine their optical microstructure. The structure showed manganese sulphide particles locked between particles of the stainless steel.

[0016] Physical measurements and mechanical tests were carried out on the pressed and sintered material. The results are show in Tables I, II and III below.

TABLE I

	316L + 20% MnS	316L + 20% WS_2
Sintered Density g/cm^3	6.33	6.80
Hardness HB	138	134
Tensile Strength N/mm^2	173	148
Compressive Strength N/mm^2	>764	>764

[0017] The sintered density of the Illustrative Example represents 96% of the maximum theoretical density of the product.

[0018] A Comparative Example was prepared according to the method of the Illustrative Example except that tungsten disulphide powder was substituted for the manganese sulphide powder. The sintered density of the Comparative Example represents 87% of the maximum theoretical density of the product.

[0019] Samples of the Comparative Example and the Illustrative Example were tested by moving a fixed load (0.7 N/mm^2) back and forth across the samples at a set speed (0.05 m/s), distance (40mm) and temperature (550°C). Table II compares the Illustrative Example with the Comparative Example. Table III shows the effect of increasing the number of strokes, and changing the counterface material.

TABLE II

	316L + WS2	316L + MnS
Double Strokes	30480	30292
Total Sliding Distance (km)	2.438	2.423
Counterface Material	A	A
Brinell hardness of counterface material	194 HB	194 HB
Friction Coefficient	0.41 - 0.46	0.41 - 0.49
Wear (μm)	310	0
Wear Rate (μm/km)	127	0

[0020] Counterface material A comprised a steel of composition 0.2% C, 12% Ni, 20% Cr, balance Fe.

[0021] From Table II it can be seen that the Illustrative Example shows far less wear than the Comparative Example at this load and temperature.

TABLE III

	316L + 20% MnS	316L + 20% MnS	316L + 20% MnS
Double Strokes	30292	49184	48500
Total Sliding Distance (km)	2.423	3.920	3.880
Counterface Material	A	A	B
Brinell hardness of counterface material	194 HB	194 HB	156 HB
Friction Coefficient	0.41 - 0.49	0.51 - 0.56	0.51 - 0.57
Wear (μm)	0	15	24
Wear Rate (μm/km)	0	4	6

[0022] Counterface material B comprised a steel of composition 0.12% C, 6.5% Cr, 0.8% Al, balance Fe.

[0023] Thus from Table III it can be seen that increasing the total sliding distance by a little over 60% will produce a detectable wear rate (4 μm/km). The wear rate can be further increased by the use of a different counterface material - in the present instance to 6μm/km. It will be noted that this is still much lower than the wear rate of the Comparative Example.

Claims

1. A sintered stainless steel based material characterised in that it comprises from 2.5 to 30 wt% manganese sulphide.

2. A material according to claim 1, characterised in that it comprises 20 wt% manganese sulphide.

3. A material according to claim 1 or claim 2, characterised in that the stainless steel is of composition 0.03% C, 2% Mn, 1% Si, 16-18% Cr, 10-14% Ni, 0.045% P, 0.03% S, balance Fe.

4. A material according to any previous claim, characterised in that the material also comprises 1 to 7 wt% titanium carbide.

5. A method of manufacturing a sintered product comprising the steps of making a mixture of a stainless steel powder and manganese sulphide, the manganese sulphide comprising from 2.5 to 30 wt% of the mixture;

   pressing the mixture and
   sintering the mixture.

6. A method according to claim 5, characterised in that the particle size of the stainless steel powder is less than 150 μm.

7. A method according to claim 5 or claim 6, characterised in that the particle size of the manganese sulphide powder is less than 50 μm.

8. A method according to claim 7, characterised in that the particle size of the manganese sulphide powder is less than 20 μm.

9. A method according to any of claims 5 to 8, characterised in that the mixture is sintered at 1150°C for 1 hour in a vacuum.

10. A method according to any of claims 9, characterised in that the mixture is sintered for up to 2 hours in a vacuum.

11. A method according to any of claims 5 to 8, characterised in that the mixture is sintered in a hydrogen/nitrogen (H_2/N_2) atmosphere.

12. A method according to any of claims 5 to 8, characterised in that the mixture is sintered in a cracked ammonia atmosphere.

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EUROPEAN SEARCH REPORT

Application Number
EP 97 20 2689

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	PATENT ABSTRACTS OF JAPAN vol. 10, no. 235 (C-366), 14 August 1986 & JP 61 067759 A (TOYOTA MOTOR CORP.), 7 April 1986, * abstract * ---	1,4,5	C22C33/02 B22F1/00 C10M111/00 F16C33/12
X	PATENT ABSTRACTS OF JAPAN vol. 18, no. 468 (C-1244), 31 August 1994 & JP 06 145916 A (NIPPON PISTON RING), 27 May 1994, * abstract * ---	1,4,5	
A	BOLTON, J.D AND GRANT, A.J.: "Heat treatment response of sintered M3/2 high speed steel composites containing additions of manganese sulphide, niobium carbide and titanium carbide" POWDER MET., vol. 39, no. 1, 1996, pages 27-35, XP000587286 ---	1-12	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	HWANG, K. -S. AND CHIOU, C. -H.: "Desulfurization of 316L stainless steel containing MnS during sintering." INT. J. POWDER METALL., vol. 30, no. 4, October 1994, TAIWAN UNIV., pages 409-412, XP002056174 ---	1-12	C22C B22F C10M F16D F16C
A	PATENT ABSTRACTS OF JAPAN vol. 18, no. 215 (C-1191), 18 April 1994 & JP 06 010103 A (HITACHI METALS LTD), 18 January 1994, * abstract * -----	1-12	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	18 February 1998	Badcock, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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